



# PATENT SPECIFICATION

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## PROVISIONAL SPECIFICATION

### Improvements in the Protection of Ferrous Metal Surfaces Subject to Contact with Hot Furnace Gases

We, WILLIAM EDWARD BALLARD, a British Subject, of 20, Croftdown Road, Harborne, Birmingham 17, in the County of Warwick, and WALTER FRED HARLOW, a British Subject, of "Lamorna," Burley Road, Quarn-  
don, near Derby, do hereby declare the nature of this invention to be as follows:—

This invention relates to the protection or ferrous metal surfaces used in high-temperature boiler installations, subject to contact with hot furnace gases, particularly super-heater tubes for the reduction or prevention of corrosion.

With the increase in steam temperatures now used in boiler installations there has been an accompanying increase in the corrosion of super-heater tubes, and in the subsidiary apparatus connected with the installation. It is believed that this corrosion may be due to the catalytic action of certain deposits on the super-heater tubes which cause the formation of sulphur trioxide from the sulphur dioxide in the flue gas.

Various proposals have been made to overcome the difficulty. One proposal is to coat the super-heater tubes with various bodies, such for instance as chalk and/or sodium carbonate. It has also been proposed to coat the super-heater tubes with aluminium by the well-known metal spraying process. These methods appear to give a decrease in catalysts and a decrease in corrosion. A more successful protection method has been suggested which is by making use of the aluminising process for the protection of the tubes. In this method of protection the tubes are sprayed with aluminium and afterwards heat treated to bring about inter-alloying of the aluminium coating and the steel of the tubes, so that the final coating is an iron aluminium alloy. This process appears to give excellent results but is somewhat difficult to apply, and there is some possibility of distorting the tubes in the heat treatment. Further, it has been proposed to use a combination of aluminium spraying and aluminising, and the protection with such bodies as chalk, sodium silicate or sodium carbonate.

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The present invention seeks to provide a protection by providing a non-catalytic coating which is as effective or more effective than an aluminising coating but which requires no heat treatment before the tubes are put into service.

According to the present invention we provide a process which includes the steps of spraying the tubes with aluminium to a suitable thickness and subsequently treating the aluminium surface with a partly hydrolysed organic silicate.

The thickness of the aluminium coating may be between .002" and .010" and the solution is allowed to dry on the aluminium coating, and several applications of the solution may be made if desired.

One method of protection which we have found to give good results is to apply a coating of aluminium by spraying with the wire process to a thickness of approximately .006" and afterwards coating the aluminium with a solution of ethyl silicate. The solution used may be as follows:

81 parts by volume industrial methylated spirits;

30 parts 0.06% hydrochloric acid;

190 parts ethyl silicate.

These materials are shaken together for a period of approximately 20 minutes, and then a further 160 parts of ethyl silicate are added and the solution is used after standing for not less than one hour, or more than six hours.

The solution may be applied to the aluminium surface by spraying or brushing, and one or more coatings may be applied.

It has been found that the aluminium deposit takes up a film of silicon which reduces or eliminates corrosion and the catalytic effect.

Dated the 28th day of August, 1947.

FORRESTER, KETLEY & CO.,  
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Jessel Chambers, 88/90, Chancery Lane,  
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## COMPLETE SPECIFICATION

Improvements in the Protection of Ferrous Metal Surfaces  
Subject to Contact with Hot Furnace Gases

We, WILLIAM EDWARD BALLARD, a British Subject, of 20, Croftdown Road, Harborne, Birmingham 17, in the County of Warwick, and WALTER FRED HARLOW, a British Subject, of "Lamorna," Burley Road, Quarndon, near Derby, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the protection of the surfaces of boiler plants and other ferrous metal surfaces which are subject to contact with hot-furnace gases, particularly to the super-heater tubes used in high temperature boiler installations, and has for its object the prevention and reduction of deposits and corrosion in the gas passages of such plants.

It has been found that when hot-furnace gases resulting from the combustion of coal, oil or other sulphur bearing fuels pass over unprotected heated steel surfaces which are relatively high in temperature, say 900° F. upwards, the sulphur dioxide formed by combustion of the sulphur is partly converted into sulphur trioxide by the catalytic action of such surfaces, to an extent depending on the surface temperature.

Some of the sulphur trioxide thus formed by uniting with the constituents of the fuel ash and the metal of the heating surface causes deposits on the surfaces at which it is produced whereas another part may combine with the water vapour present to form sulphuric acid which condenses on the cooler surfaces forming further deposits and causing corrosion in this zone.

The purpose of the invention is to prevent such deposits and corrosion which cause serious inefficiency and deterioration, the invention operating by suppressing the catalytic formation of sulphur trioxide on the high temperature surfaces referred to.

Various proposals have been made to achieve this object. One proposal is to coat the high temperature surfaces with various bodies such for instance as lime or sodium carbonate, but these materials, although extremely effective in reducing catalysis and its resulting effects, do not have a permanent action so that repeated applications are necessary.

In order to provide a more permanent treatment it has been proposed to use the aluminising process followed by the application of lime and sodium silicate. In this process the tubes are first coated with aluminium by the well-known metal spraying

process and afterwards heat treated to bring about inter-alloying of the aluminium coating and the steel of the tubes to produce a coating of iron aluminium alloy. This process appears to give excellent results but is somewhat difficult to apply and there is the possibility of distorting the tubes in the heat treatment.

The present invention seeks to provide a protection by providing a non-catalytic coating which is as effective or more effective than an aluminising coating but which requires no heat treatment before the tubes are put into service.

According to the present invention we provide a process of protecting ferrous metal surfaces subject to contact with heat-furnace gases which includes the steps of spraying the surfaces with aluminium to a suitable thickness and subsequently treating the aluminium surface with a partly hydrolysed organic silicate.

The thickness of the aluminium coating may be between .002" and .010" and the solution is allowed to dry on the aluminium coating, and several applications of the solution may be made if desired.

One method of protection which we have found to give good results is to apply a coating of aluminium by spraying with the wire process to a thickness of approximately .006" and afterwards coating the aluminium with a solution of ethyl silicate. The solution used may be as follows:

81 parts by volume industrial methylated spirits;

33 parts 0.06% hydrochloric acid;

190 parts ethyl silicate.

These materials are shaken together for a period of approximately twenty minutes, and then a further 160 parts of ethyl silicate are added and the solution is used after standing for not less than one hour, or more than six hours.

The solution may be applied to the aluminium surface by spraying or brushing, and one or more coatings may be applied.

It has been found that the aluminium deposit takes up a film of silicon which reduces or eliminates corrosion and the catalytic effect.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A method of protecting ferrous metal surfaces against corrosion due to contact with hot surface gases which includes the steps of spraying the surfaces with alumin-

ium to a suitable thickness and subsequently treating the aluminium surface with a partly hydrolysed organic silicate.

2. A method according to Claim 1 where-  
5 in a solution of ethyl silicate is used for treating the aluminium surface.

3. A method according to Claim 2 where-  
in the solution used comprises a mixture of  
81 parts by volume industrial methylated  
10 spirits, 30 parts 0.06% hydrochloric acid and  
190 parts ethyl silicate to which are subse-  
quently added a further amount of ethyl sili-

cate equal to 160 parts.

4. A method of protecting super-heater  
tubes against corrosion substantially as here- 15  
inbefore described.

Dated the 9th day of August, 1948.

FORRESTER, KETLEY & CO.,

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